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(54) FOAMING OIL-IN-WATER TYPE EMULSIONS AND PROCESS FOR PRODUCING THE SAME

(57) It is intended to provide foaming oil-in-water type emulsions having extremely short whipping time and excellent heat-resistant shape retention and yet showing high overrun (more specifically, from 250 to 400% overrun). Namely, a foaming oil-in-water type emulsion comprising fats and saccharides as the main components and containing from 30 to 55% by weight of total solid matters, wherein the content of casein-containing proteins amounts to 0.05 to 0.8% by weight in terms of solid matters in the emulsion and the total protein content amounts to 0.05 to 0.8% by weight in terms of solid matters.

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Description

Technical Field

[0001] The present invention relates to a foaming oil-in-water type emulsion showing high overrun, more specifically from 250 to 400% overrun, and having extremely shorter whipping time than that of a conventional foaming oil-in-water type emulsion and excellent heat-resistant shape retention, and to a process for producing the same.

Background Art

[0002] Every cream, for example, whipped cream used in such as cake and parfait and filling cream used in bread as filling, is usually a foaming oil-in-water type emulsion prepared by stirring a homogeneous oil-in-water type emulsion which comprises fat, protein, sugars, emulsifier, water, stabilizer, flavor and so on while aerating. In recent changes in food culture, a trend toward light texture is just as valid for foaming oil-in-water type emulsions, that is high overrun. JP 2 -128644 A has proposed a foaming oil-in-water type emulsion excellent as filling and topping materials for confectionary and bakery, cooking materials and so on, which has improved shelf life, suitableness on the circulation and good taste and is excellent in heat-resistant shape retention and resistance for demulsifying regardless of high overrun. However, the high overrun can only go so far as 130%, and whipping time takes about 3 to 5 minutes. To reduce whipping time is the longstanding demand of the confectionary and bakery industry, in terms of reduction of work hours and stabilization of work.

Disclosure of Invention

[0003] An object of the present invention is to provide a foaming oil-in-water type emulsion having extremely short whipping time and excellent heat-resistant shape retention yet showing high overrun, more specifically from 250 to 400% overrun, and a process for producing the same.

[0004] The present inventors have studied intensively to solve the above problems. As a result, the present inventors have accomplished the present invention by using a casein-containing protein in a specific amount and reducing significantly an amount of total proteins.

[0005] That is, the first aspect of the present invention is a foaming oil-in-water type emulsion comprising fats and saccharides as main components and containing from 30 to 55% by weight of total solid matters, wherein a content of casein-containing protein is from 0.05 to 0.8% by weight in terms of the solid matters in the emulsion and, concurrently, a content of total proteins is from 0.05 to 0.8% by weight in terms of the solid matters. The second aspect is the foaming oil-in-water type emulsion according to the first aspect, wherein an average particle diameter of fat particles in the foaming oil-in-water type emulsion. is within the range from 0.4 to 1.2 μm. The third aspect is the foaming oil-in-water type emulsion according to the first or second aspect, wherein overrun of a foamed matter of the foaming oil-in-water type emulsion is from 250 to 400%. The fourth aspect is a process for producing a foaming oil-in-water type emulsion comprising fats and saccharides as the main components, said process comprising using 30 to 55% by weight of total solid matters. wherein casein-containing protein is used in an amount of 0.05 to 0.8% by weight in terms of the solid matters and, concurrently, total proteins are used in an amount of 0.05 to 0.8% by weight in terms of the solid matters in the emulsion. The fifth aspect is the process according to the fourth aspect, wherein the fat particles in the emulsion are processed so that their average particle diameter is within the range from 0.4 to 1.2 μm.

Best Mode for Performing the Invention

[0006] The foaming oil-in-water type emulsion of the present invention comprises fats and saccharides as the main components, contains 30 to 55% by weight of total solid matters, contains 0.05 to 0.8% by weight of casein-containing protein in terms of the solid matters and, concurrently contains 0.05 to 0.8% by weight of total proteins in terms of the solid matters in the emulsion.

[0007] Examples of fats of the present invention include one or a mixture of two or more of animal and plant fats and hydrogenated fats thereof and chemically- or physically-processed matters thereof. Examples of such fats include animal and plant fats such as soybean oil, cottonseed oil, corn oil, safflower oil, olive oil, palm oil, rapeseed oil, rice bran oil, sesame oil, kapok oil, coconut oil, palm kernel oil, cacao oil, milk fat, lard, fish oil, whale oil, and hydrogenated oil thereof, and processed fats (having a melting point about 15 to 40°C) such as fractionated oil, interesterified oil and so on.

[0008] Examples of saccharides of the present invention include monosaccharides, oligosaccharides, sugar alcohols, dextrin, starch syrup and so on. Specifically, as the monosaccharides, there are, for instance, glucose, fructose, mannose, xylose and so on. Examples of the oligosaccharide usually include from disaccharides to hexasaccharides,

and, specifically, there are, for instance, sucrose, maltose, lactose, trehalose, maltotriose and so on. Specific examples of sugar alcohols include sorbitol, maltitol, mannitol, erythritol, xylitol, oligosaccharide alcohols and so on.

[0009] The foaming oil-in-water type emulsion of the present invention comprises fats and saccharides as the main components and contains protein(s), which needs to contain 30 to 55% by weight, preferably by 40 to 55% by weight of total solid matters. When the total amount of solid matters is lower than 30% by weight, shape retention at the optimal foamed state tends to be deteriorated. When higher than 55% by weight, overrun tends to be decreased.

[0010] Examples of proteins used in the present invention include proteins derived from milk, defatted milk, sweetened condensed milk, unsweetened condensed milk, whole milk powder, skim milk powder, buttermilk, buttermilk powder, whey, whey powder, casein, casein sodium, lactalbumin, fresh cream and so on, and also include proteins other than milk protein such as egg protein and soybean protein. As egg protein, there are liquid or dried yolk, white and whole egg, as well as single (simple) protein isolated therefrom, for example, ovalbumin, conalbumin, ovomucoid, ovoglobulin and so on. Examples of soybean protein include soybean milk, defatted soybean flour, condensed soybean protein, soybean protein isolate, defatted soybean milk powder, soybean protein hydrolyzate and so on.

[0011] Examples of casein-containing protein used in the present invention include total milk protein obtained by defatting and ultrafiltrating (UF) milk and/or casein and casein sodium obtained from milk by acid precipitation by addition of an acid or by lactic fermentation and/or by precipitation by addition of rennet or calcium and so on.

[0012] As the protein used in the present invention, an above-mentioned protein is used. However, it is necessary that the total amount of proteins in the foaming oil-in-water type emulsion is within the range from 0.05 to 0.8% by weight in terms of the solid matters. In case of below the lower limit, a larger average particle diameter is resulted, which causes decreased overrun. Then, shape retention at the optimal foamed state tends to be deteriorated. In case of above the higher limit, longer whipping time is resulted, and shape retention at the optimal state tends to be deteriorated.

[0013] In addition, concurrently, it is necessary to contain casein-containing protein within the range from 0.05 to 0.8% by weight in terms of the solid matters. The casein-containing protein is included in the total proteins. When an amount of casein-containing protein is below the lower limit, a larger average particle diameter is resulted, which causes decreased overrun. Then, shape retention at the optimal foamed state tends to be deteriorated. When higher than the upper limit, whipping time tends to be longer.

[0014] An average particle diameter of the fat particles in the foaming oil-in-water type emulsion of the present invention is preferably within the range from 0.4 to 1.2 μm, more preferably within the range from 0.6 to 1.1 μm, still more preferably within the range from 0.7 to 1.1 μm. Examples of means for adjusting an average particle diameter of the fat particles include a high-speed rotary stirring and dispersing machine such as homomixer, Shurflo, Silverson mixer, an ultrasonic emulsifier such as Ultrajetter, Dispersonic, pressure nozzle emulsifier (homogenizer)

[0015] The much smaller the average particle diameter of the fat particles, the longer the time is required to whip. Contrary, too large average particle diameter decreases overrun, and shape retention at the optimal foamed state tends to be deteriorated.

[0016] An average particle diameter as used in the present invention refers to a particle diameter corresponding to 50% of cumulative distribution in terms of particle diameter volume, which is a value measured by laser scattering particle size distribution analyzer (LA500, manufactured by Horiba, Ltd.).

[0017] Preferably, the foaming oil-in-water type emulsion of the present invention has short whipping time and overrun from 250 to 400%. As for a foaming instrument, there are batch type and continuous type, and the batch type is more effective in the term of short whipping time in the present invention. Examples of the batch type include, Kenmix, Hobart-mixer, Kanto-mixer and so on. Examples of the continuous type include Whip master FT40 (manufactured by Itochu Footech Co. Ltd), Turbo-Mix TM300 (manufactured by Aicohsha Manufacturing Co., Ltd.) and so.on.

[0018] The foaming oil-in-water type emulsion of the present invention can have whipping time about 40 seconds to 2 minutes, while the whipping time of conventional foaming oil-in-water type emulsions is about 3 minutes to 5 minutes.

[0019] The overrun of a foamed matter is preferably 250 to 400%, and more preferably 270 to 370%. In case of too low overrun, a fluffy light texture of interest cannot be obtained. In case of too high overrun, shape retention at the optimal foamed state tends to be deteriorated.

[0020] When producing the foaming oil-in-water type emulsion of the present invention, a synthetic emulsifier that have been used conventionally, such as lecithin, monoglyceride, sorbitan fatty acid ester, propylene glycol fatty acid ester, polyglycerol ester of fatty acid, sucrose ester of fatty acid, may be used.

[0021] In the foaming oil-in-water type emulsion of the present invention, it is preferred to use various salts, and preferred to use alone or in combination of two or more of hexametaphosphate, dibasic phosphate, sodium citrate, polyphosphate, baking soda and so on.

[0022] In addition, if desired, a flavor, a colorant and/or a preservative may be used.

[0023] The process for producing the foaming oil-in-water type emulsion of the present invention may be performed in a manner of producing conventional cream. Specific example thereof will be illustrated hereinafter. Each raw material is pre-emulsified for 20 minutes at 60 to 70°C (a homomixer is used as an emulsifying equipment), and then, if nec-

essary, homogenized under conditions of.70 to 250 Kg/cm^2 (a homogenizer is used as an emulsifying equipment). The material is then processed with ultra high temperature (UHT), thereafter homogenized again under conditions of 70 to 250 Kg/cm^2, cooled, and aged for about 24 hours. Homogenization may be performed either before or after of sterilization, or may be two-step emulsification in combination of both.

[0024] There are two methods of ultra high temperature (UHT) sterilization: indirect heating and direct heating. Examples of an indirect heating apparatus include, but not limited to, APV plate-type UHT treatment apparatus (manufactured by APV Co. Ltd.), CP-UHT sterilizer (manufactured by Climaty Package Co. Ltd.), Stork tubular-type sterilizer (manufactured by Stork Food & Dairy Systems Inc.), Contherm scraped surface UHT sterilizer (manufactured by Tetra pak Alfa-Laval Co. Ltd.) and so on. Examples of a direct heating sterilizer include UHT sterilizer such as UHT Sterilizer (manufactured by IWAI Engineering System Co. Ltd.), Uperization sterilizer (manufactured by Tetra pak Alfa-Laval Co. Ltd.), VTIS sterilizer (manufactured by Tetra pak Alfa-Laval Co..Ltd.), Lagear UHT sterilizer (manufactured by Lagear Co. Ltd.), Paralyzator (manufactured by Pash and Silkevogue Co. Ltd.) and so on. Any apparatus of them may be used.

Examples

[0025] Hereinafter, the present invention will be illustrated in detail by Examples. However, the following Examples are not construed to limit the spirit of the present invention. It is noted that all the "parts" and "%" are by weight. Particularly, it goes without saying that orders of addition of additives or emulsification in which an oil phase is add to an aqueous phase or the aqueous phase is add to the oil phase would not be limited by the following Examples.

[0026] Results were evaluated according to the following methods.

(1) whipping time: time to achieve the optimal foamed state for 500 g of a foaming oil-in-water type emulsion by whipping with Kenmix (manufactured by Aicohsha Manufacturing Co., Ltd., type: 302-E-004) at scale 5 (rate at 240 rpm).

(2) overrun: [(mass of an oil-in-water type emulsion in determined volume)-(mass of foamed matter in determined volume)] ÷ (mass of foamed matter in determined volume) x 100

(3) shape retention: fineness of a flower-shaped foamed matter after 24 hours standing at 15°C on a scale of 4-point scale.

A: good
B: slightly good
C: slightly bad
D: bad (impractical)

(4) texture: evaluating the state of texture simultaneously with the evaluation of the shape retention on a scale of 3-point scale.

◎ excellent
○ good
× bad

(5) syneresis: evaluating the state of syneresis simultaneously with the evaluation of the shape retention on a scale of 4-point scale.

- not occurred
- + slightly occurred
+ occurred
++ considerably occurred

Example 1

[0027] To. 12.0 parts of hydrogenated coconut oil and 12.5 parts of hydrogenated palm kernel oil were added 0.1 parts of lecithin and 0.2 parts of sorbitan monostearate (manufactured by Kao Corporation, trade name: Emasol S-10F) and the resultant mixture was stirred to prepare an oil phase.

[0028] Aside from this, 20.0 parts of sugar, 0.6 part of casein sodium L (manufactured by San-Ei Gen F.F.I., Inc., casein-containing protein 91%), 0.2 parts of sugar ester (manufactured by Mitsubishi-Kagaku Foods Corporation, trade name: S-570), 0.1 part of sodium hexametaphosphate (0.1 part) and 0.02 part of baking soda were dissolved in 54.28 parts of water to prepare an aqueous phase. The above oil phase and aqueous phase were stirred with a homomixer

for at 65°C for 30 minutes to conduct pre-emulsification, and then sterilized by direct heating at 145°C for 4 seconds with UHT Sterilizer (manufactured by IWAI Engineering System Co. Ltd.), homogenized at homogenizing pressure of 100 Kg/cm^2, and immediately after that, cooled to 5°C. After cooling, the resultant emulsion was aged for about 24 hours to obtain a foaming oil-in-water type emulsion (total solid matters: 45.6% by weight, total proteins: 0.55% by weight, casein-containing protein: 0.55% by weight, average particle diameter: 0.55 μm). The emulsion was evaluated according to the above whipping method.

Example 2

[0029] To 24.5 parts of palm kernel oil were added 0.1 part of lecithin and 0.2 part of stearic acid monoglyceride (manufactured by Riken Vitamin Co. Ltd., trade name: Emulsee MS), and the resultant mixture was stirred to prepare an oil phase.

[0030] Aside from this, 17.0 parts of sugar, 0.3 part of casein sodium L (manufactured by San-Ei Gen F.F.I., Inc., casein-containing protein 91%), 0.2 part of sugar ester (manufactured by Mitsubishi-Kagaku Foods Corporation, trade name: S-570), 0.1 part of sodium hexametaphosphate and 0.02 part of baking soda were dissolved in 57.58 parts of water to prepare an aqueous phase. The above oil phase and aqueous phase were stirred with a homomixer at 65°C for 30 minutes to conduct pre-emulsification, and then sterilized by direct heating at 145°C for 4 seconds with UHT Sterilizer (manufactured by IWAI Engineering System Co. Ltd.), homogenized at homogenizing pressure of 200 Kg/cm^2, and, immediately after that, cooled to 5°C. After cooling, the resultant emulsion was aged for about 24 hours to obtain a foaming oil-in-water type emulsion (total solid matters: 42.3% by weight, total proteins: 0.27% by weight, casein-containing protein: 0.27% by weight, average particle diameter: 0.80 μm). The emulsion was evaluated according to the above whipping method.

Example 3

[0031] To 12.5 parts of hydrogenated palm middle melting point oil and 12.0 parts of palm kernel oil were added.0.1 part of lecithin and 0.2 part of sorbitan monostearate (manufactured by Kao corporation, trade name: Emasol S-10F), and the resultant mixture was stirred to prepare an oil phase.

[0032] Aside from this, 28.0 parts of maltose, 0.3 part of casein sodium L (manufactured by San-Ei Gen F.F.I., Inc., casein-containing protein 91%), 0.4 part of egg yolk, 0.2. part of sugar ester (manufactured by Mitsubishi-Kagaku Foods Corporation, trade name: S-570), 0.1 part of sodium hexametaphosphate and 0.02 parts of baking soda were dissolved in 46.18 parts of water to prepare an aqueous phase. The above oil phase and aqueous phase were stirred with a homomixer at 65°C for 30 minutes to conduct pre-emulsification, and then sterilized by direct heating at 145°C for 4 seconds with UHT Sterilizer (manufactured by IWAI Engineering System Co. Ltd.), homogenized at homogenizing pressure of 200 Kg/cm^2, and, immediately after that, cooled to 5°C. After cooling, the resultant emulsion was aged for about 24 hours to obtain a foaming oil-in-water type emulsion (total solid matters: 52.1% by weight, total proteins: 0.39% by weight, casein-containing protein: 0.27% by weight, average particle diameter: 0.46 μm). The emulsion was evaluated according to the above whipping method.

Example 4

[0033] To. 24.5 parts of palm kernel oil were added 0.1 part of lecithin and 0.2 part of sorbitan monostearate. (manufactured by Kao corporation, trade name: Emasol S-10F). and the resultant mixture was stirred to prepare an oil phase.

[0034] Aside from this, 15.0 parts of maltose, 0.3 part of casein sodium L (manufactured by San-Ei Gen F.F.I., Inc., casein-containing protein 91%), 0.2 part of sugar ester (manufactured by Mitsubishi-Kagaku Foods Corporation, trade name: S-570), 0.1 part of sodium hexametaphosphate and 0.02 part of baking soda were dissolved in 59.58 parts of water to prepare an aqueous phase. The above oil phase and aqueous phase were stirred with a homomixer at 65°C for 30 minutes to conduct pre-emulsification, and then sterilized by direct heating at 145°C for 4 seconds with UHT Sterilizer (manufactured by IWAI Engineering System Co. Ltd.), and then homogenized at homogenizing pressure of 200 Kg/cm^2, and immediately after that, cooled to 5°C. After cooling, the resultant emulsion was aged for about 24 hours to obtain a foaming oil-in-water type emulsion (total solid matters: 39.4% by weight, total proteins: 0.27% by weight, casein-containing protein: 0.27% by weight, average particle diameter: 0.81 μm). The emulsion was evaluated according to the above whipping method.

Example 5

[0035] To 24.5 parts of palm kernel oil were added 0.1 part of lecithin and 0.2 part of sorbitan monostearate (manufactured by Kao corporation, trade name: Emasol S-10F), and the resultant mixture was stirred to prepare an oil phase.

[0036] Aside from this, 10.0 parts of maltose, 0.3 part of casein sodium L (manufactured by San-Ei Gen F.F.I., Inc., casein-containing protein 91%), 0.2 part of sugar ester (Mitsubishi-Kagaku Foods Corporation, trade name: S-570), 0.1 part of sodium hexametaphosphate and 0.02 part of baking soda were dissolved in 64.58 parts of water to prepare an aqueous phase. The above oil phase and aqueous phase were stirred with a homomixer at 65°C for 30 minutes to conduct pre-emulsification, and then sterilized by direct heating at 145°C for 4 seconds with UHT Sterilizer (manufactured by IWAI Engineering System Co. Ltd.), homogenized at homogenizing pressure of 200 Kg/cm^2, and immediately after that, cooled to 5°C. After cooling, the resultant emulsion was aged for about 24 hours to obtain a foaming oil-in-water type emulsion (total solid matters: 34.7% by weight, total proteins: 0.27% by weight, casein-containing protein: 0.27% by weight, average particle diameter: 0.90 μm). The emulsion was evaluated according to the above whipping method.

[0037] Results of Examples 1 to 5 are summarized in Table 1.

Table 1

	Example 1	Example 2	Example 3	Example 4	Example 5
whipping time	1'30"	50"	39"	44"	53"
overrun (%)	272	310	268	329	380
shape	A	A	A	A	B
retention texture	○	◎	◎	○	○
syneresis	-	-	-	-+	-+
particle diameter	0.55	0.80	0.46.	0.81	0.90

Comparative Example 1

[0038] To 12.0 parts of hydrogenated coconut oil and 12.5 parts of hydrogenated palm kernel oil were added 0.1 part of lecithin and 0.2 part of sorbitan monostearate (manufactured by Kao corporation, trade name: Emasol S-10F) and the resultant mixture was stirred to prepare an oil phase.

[0039] Aside from this, 20.0 parts of sugar, 0.03 part of casein sodium L (manufactured by San-Ei Gen F.F.I., Inc., casein-containing protein 91%), 0.2 part of sugar ester (manufactured by Mitsubishi-Kagaku Foods Corporation, commercial name: S-570), 0.1 part of sodium hexametaphosphate and 0.02 part of baking soda were dissolved in 54.85 parts of water to prepare an aqueous phase. The above oil phase and aqueous phase were stirred with a homomixer at 65°C for 30 minutes to conduct pre-emulsification, and then sterilized by direct heating at 145°C with UHT Sterilizer (manufactured by IWAI Engineering System Co. Ltd.) for four seconds, homogenized at homogenizing pressure of 200 Kg/cm^2, and immediately after that, cooled to 5°C. After cooling, the resultant emulsion was aged for about 24 hours to obtain a foaming oil-in-water type emulsion (total solid matters: 45.1% by weight, total proteins: 0.03% by weight, casein-containing protein: 0.03% by weight, average particle diameter: 15.23 μm). The emulsion was evaluated according to the above whipping method.

Comparative Example 2

[0040] To 12.0 parts of hydrogenated coconut oil and 12.5 parts of hydrogenated palm kernel oil were added 0.1 part of lecithin and 0.2 part of sorbitan monostearate (manufactured by Kao corporation, trade name: Emasol S-10F) and the resultant mixture was stirred to prepare an oil phase.

[0041] Aside from this, 22.0 parts of sugar, 4.0 parts of skim milk powder, 0.2 part of sugar ester (Mitsubishi-Kagaku Foods Corporation, trade name: S-570), 0.1 part of sodium hexametaphosphate and 0.02 part of baking soda were dissolved in 48.88 parts of water to prepare an aqueous phase. The above oil phase and aqueous phase were stirred with a homomixer at 65°C for 30 minutes to conduct pre-emulsification, and then sterilized by direct heating at 145°C for 4 seconds with UHT Sterilizer (manufactured by IWAI Engineering System Co. Ltd.), homogenized at homogenizing pressure of 200 Kg/cm^2. immediately after that, cooled to 5°C. After cooling, the resultant emulsion was aged for about 24 hours to obtain a foaming oil-in-water type emulsion (total solid matters: 49.8% by weight, total proteins:1.48% by weight, casein-containing protein: 1.18% by weight, average particle diameter: 0.60 μm). The emulsion was evaluated according to the above whipping method.

Comparative Example 3

[0042] To 12.0 parts of hydrogenated coconut oil and 12.5 parts of hydrogenated palm kernel oil were added 0.1 part of lecithin and 0.2 part of sorbitan monostearate (manufactured by Kao corporation, trade name: Emasol S-10F)

and the resultant mixture was stirred to prepare an oil phase.

[0043] Aside from this, 20.0 parts of sugar, 0.3 part of casein sodium L (manufactured by San-Ei Gen F.F.I., Inc., casein-containing protein 91%), 0.2 part of sugar ester (manufactured by Mitsubishi-Kagaku Foods Corporation, trade name: S-570), 0.1 part of sodium hexametaphosphate and 0.02 part of baking soda were dissolved in 54.58 parts of water to prepare an aqueous phase. The above oil phase and aqueous phase were stirred with a homomixer at 65°C for 30 minutes to conduct pre-emulsification, and then sterilized by direct heating at 145°C for 4 seconds with UHT Sterilizer (manufactured by IWAI Engineering System Co. Ltd.), homogenized at homogenizing pressure of 50 Kg/cm^2, and immediately after that, cooled to 5°C. After cooling, the resultant emulsion was aged for about 24 hours to obtain a foaming oil-in-water type emulsion (total solid matters: 45.4% by weight, total proteins: 0.27% by weight, casein-containing protein: 0.27% by weight, average particle diameter: 1.40 μm). The emulsion was evaluated according to the above whipping method.

Comparative Example 4

[0044] To 15.0 parts of palm kernel oil were added 0.1 part of lecithin and 0.2 part of Sorbitan Monostearate (manufactured by Kao corporation, trade name: Emasol S-10F) and stirred to prepare an oil phase.

[0045] Aside from this, 10.0 parts of maltose, 0.3 part of casein sodium L (manufactured by San-Ei Gen F.F.I., Inc., casein-containing protein 91%), 0.2 part of sugar ester (manufactured by Mitsubishi-Kagaku Foods Corporation, trade name: S-570), 0.1 part of sodium hexametaphosphate and 0.02 part of baking soda were dissolved in 74.08 parts of water to prepare an aqueous phase. The above oil phase and aqueous phase were stirred with a homomixer at 65°C for 30 minutes to conduct pre-emulsification, and then sterilized by direct heating at 145°C for 4 seconds with UHT Sterilizer (manufactured by IWAI Engineering System Co. Ltd.), and then homogenized at homogenizing pressure of 200 Kg/cm^2, and immediately after that, cooled to 5°C. After cooling, the resultant emulsion was aged for about 24 hours to obtain a foaming oil-in-water type emulsion (total solid matters: 25.2% by weight, total proteins: 0.27% by weight, casein-containing protein: 0.27% by weight, average particle diameter: 1.15 μm). The emulsion was evaluated according to the above whipping method.

Comparative Example 5

[0046] To 29.5 parts of palm kernel oil were added 0.1 part of lecithin and 0.2 part of monoglycerin fatty acid ester (manufactured by Riken Vitamin Co. Ltd., trade name: Emulsee MS) and the resultant mixture was stirred to prepare an oil phase.

[0047] Aside from this, 30.0 parts of sugar, 0.3 part of casein sodium L (manufactured by San-Ei Gen F.F.I., Inc., casein-containing protein 91%), 0.2 part of sugar ester (manufactured by Mitsubishi-Kagaku Foods Corporation, trade name: S-570), 0.1 part of sodium hexametaphosphate and 0.02 part of baking soda were dissolved in 39.58 parts of water to prepare an aqueous phase. The above oil phase and aqueous phase were stirred with a homomixer at 65°C for 30 minutes to conduct pre-emulsification, and then sterilized by direct heating at 145°C for 4 seconds with UHT Sterilizer (manufactured by IWAI Engineering System Co. Ltd.), homogenized at homogenizing pressure of 200 Kg/cm^2, and immediately after that, cooled to 5°C. After cooling, the resultant emulsion was aged for about 24 hours to obtain a foaming oil-in-water type emulsion (total solid matters: 60.3% by weight, total proteins: 0.27% by weight; casein-containing protein: 0.27% by weight, average particle diameter: 0.46 μm). The emulsion was evaluated according to the above whipping method.

[0048] Results of Comparative Examples 1 to 5 are summarized in Table 2.

Table 2

	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5
whipping time	44"	4' 13"	1'20"	3' 45"	55"
overrun (%)	160	180	150	365	155
shape	C	C	D	D	A
retention texture	×	×	×	×	○
syneresis	-+	+++	+++	+++	-
particle diameter	15.23	0.60	1.40	1.15	0.46

Industrial Applicability

[0049] According to the present invention, it is possible to provide a foaming oil-in-water type emulsion having extremely short whipping time and excellent heat-resistant shape retention yet showing high overrun, more specifically from 250 to 400% overrun, and a process for producing the same.

Claims

1. A foaming.oil-in-water type emulsion comprising fats and saccharides as main components and containing from 30 to 55% by weight of total solid matters, wherein a content of casein-containing protein is from 0.05 to 0.8% by weight in terms of the solid matters in the emulsion and, concurrently, a content of total proteins is from 0.05 to 0.8% by weight in terms of the solid matters.

2. The foaming oil-in-water type emulsion according to claim 1, wherein an average particle diameter of fat particles in the foaming oil-in-water type emulsion is within the range from 0.4 to 1.2 μm.

3. The foaming oil-in-water type emulsion according to claim 1 or 2, wherein overrun of a foamed matter of the foaming oil-in-water type emulsion is from 250 to 400%.

4. A process for producing a foaming oil-in-water type emulsion comprising fats and saccharides as the main components, said process comprising using 30 to 55% by weight of total solid matters, wherein casein-containing protein is used in an amount of 0.05 to 0.8% by weight in terms of the solid matters and, concurrently, total proteins are used in an amount of 0.05 to 0.8% by weight in terms of the solid matters in the emulsion.

5. The process according to claim 4, wherein the fat particles in the emulsion are processed so that their average particle diameter is within the range from 0.4 to 1.2 μm.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/09801

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] A23L1/19, A23D7/00, A23G3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] A23L1/19, A23D7/00, A23G3/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 10-88184 A (Kaneka Corp.), 07 April, 1998 (07.04.98), (Family: none)	1-5
A	EP 540086 A1 (Unilever PLC), 05 May, 1993 (05.05.93), & AU 9227270 A & CA 2081436 A & JP 5-219909 A	1-5
A	JP 10-3227790 A (Fuji Oil Co., Ltd.), 15 December, 1998 (15.12.98), (Family: none)	1-5

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 December, 2002 (13.12.02)	14 January, 2003 (14.01.03)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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